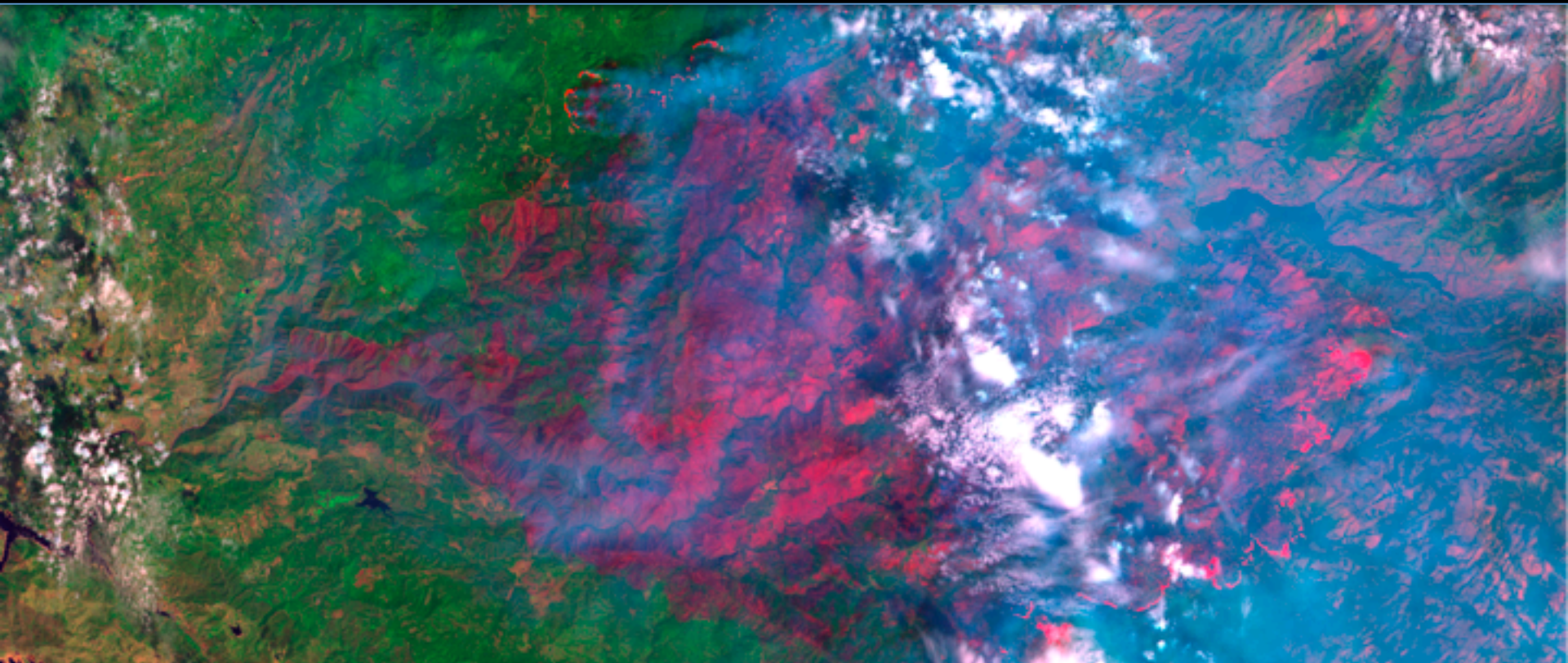




SUSTAINABLE LAND IMAGING ARCHITECTURE STUDY INDUSTRY & PARTNER DAY

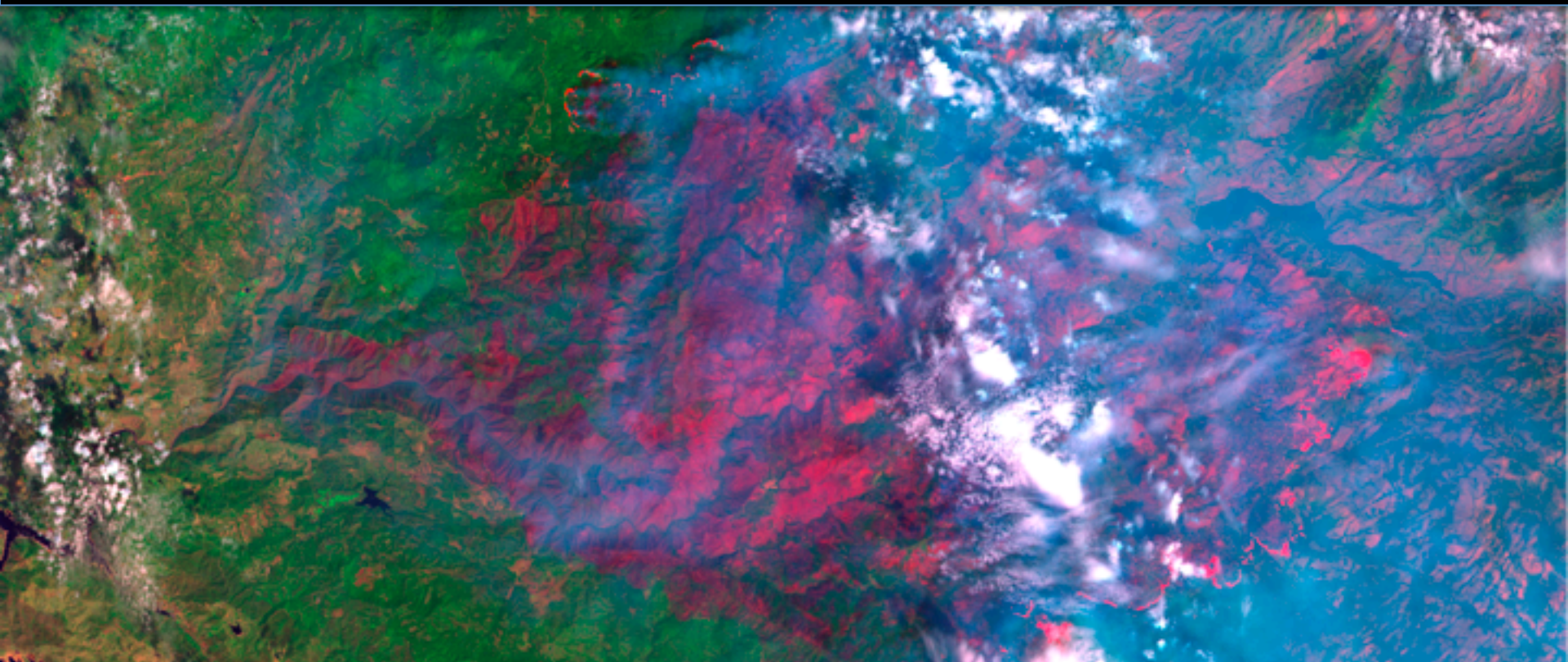


**NASA Headquarters
Washington, DC**

September 18, 2013



SUSTAINABLE LAND IMAGING ARCHITECTURE STUDY INDUSTRY & PARTNER DAY



Opening Statements

Stephen Volz
Associate Director for Flight Programs
NASA Earth Science Division
September 18, 2013

Introductions

Stephen Volz	Associate Director for Flight Programs NASA Earth Science Division
David Radzanowski	NASA Chief of Staff
Peter Colohan	Senior Policy Analyst, Environment & Energy Office of Science and Technology Policy
Sarah Ryker	Deputy Associate Director, Climate & Land Use Change U.S. Geological Survey
Michael Freilich	Director NASA Earth Science Division
David Jarrett	Program Executive NASA Earth Science Division

Agenda

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1:00-1:30	Check-in	
1:30-1:45	Introductions and Opening Statements	Stephen Volz Associate Director for Flight Programs NASA Earth Science Division
1:45-2:00	Welcome	David Radzanowski NASA Chief of Staff
2:00-2:15	Office of Science and Technology Policy Perspective	Peter Colohan Senior Policy Analyst, Environment & Energy Office of Science and Technology Policy Executive Office of the President
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3:45-4:30	Questions & Answers	Stephen Volz

Questions

- Please hold your questions until the Question and Answer period at the end of the day
- Questions from those watching online can be submitted to the following e-mail address:

HQ-LandImaging-RFI@mail.nasa.gov

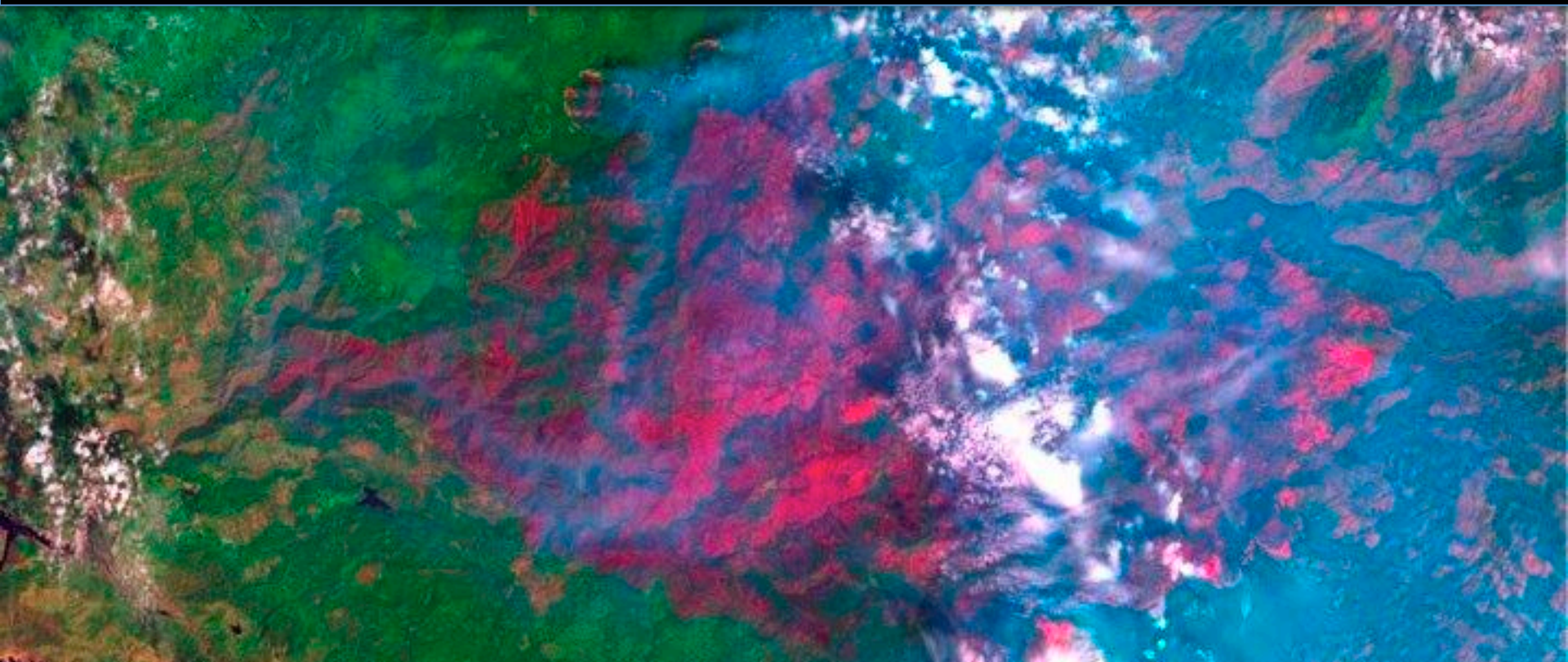
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Welcome

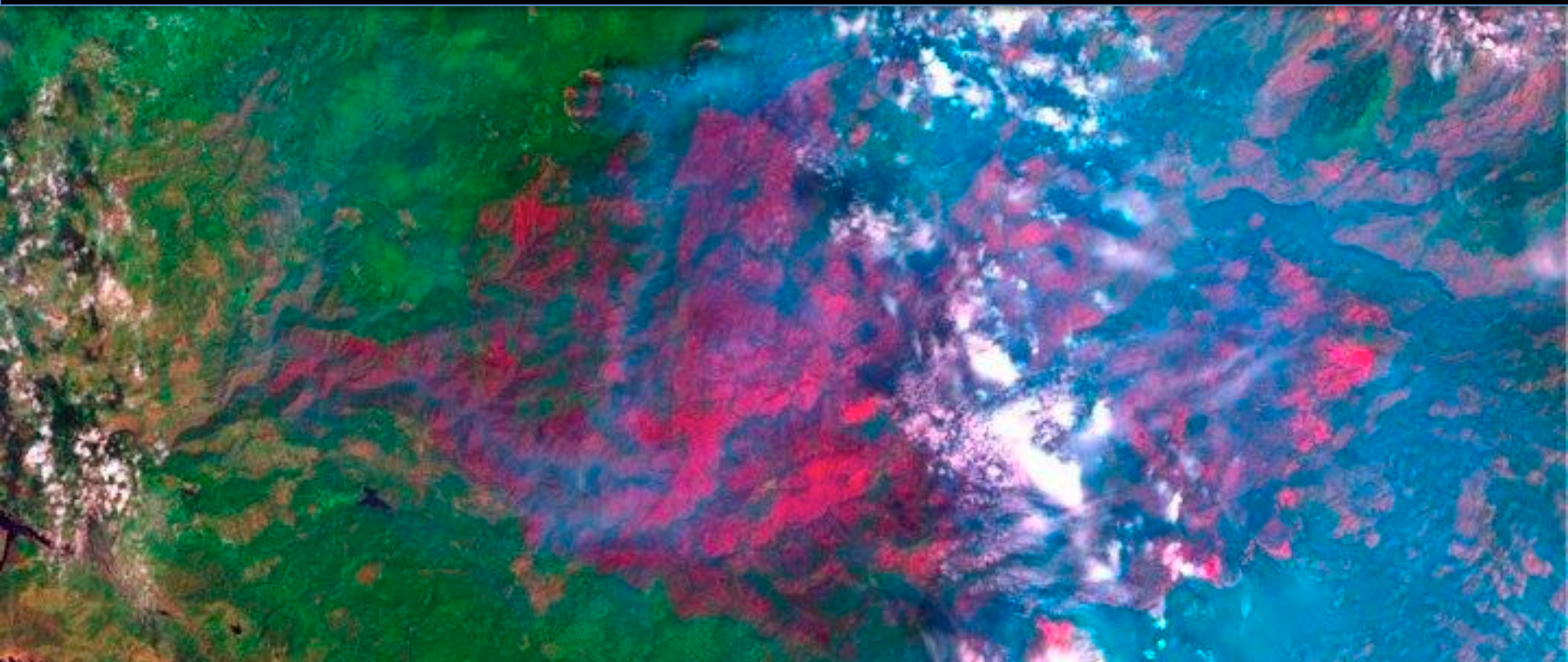
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NASA Chief of Staff
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Office of Science and Technology Policy Perspective

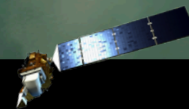
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SUSTAINABLE LAND IMAGING ARCHITECTURE STUDY INDUSTRY & PARTNER DAY



Landsat Program Overview

Sarah J. Ryker
Deputy Associate Director, Climate & Land Use Change
U.S. Geological Survey
September 18, 2013

*Landsat 8 – Operational Land Imager (OLI)
image taken May 28, 2013 of the
Copper River – Gulf of Alaska*

Landsat Mission

Objective:

- Acquire, archive, and distribute multispectral imagery affording global, synoptic, and repetitive coverage of the Earth's land surfaces at a scale where natural and human-induced changes can be detected, differentiated, characterized, and monitored over time.

Importance:

- The importance of Landsat derives not only from current sensor observations, but also from **long-term data archiving, a global data acquisition strategy, an open data policy, rigorous calibration, and a commitment to data continuity.**

Operational Continuity:

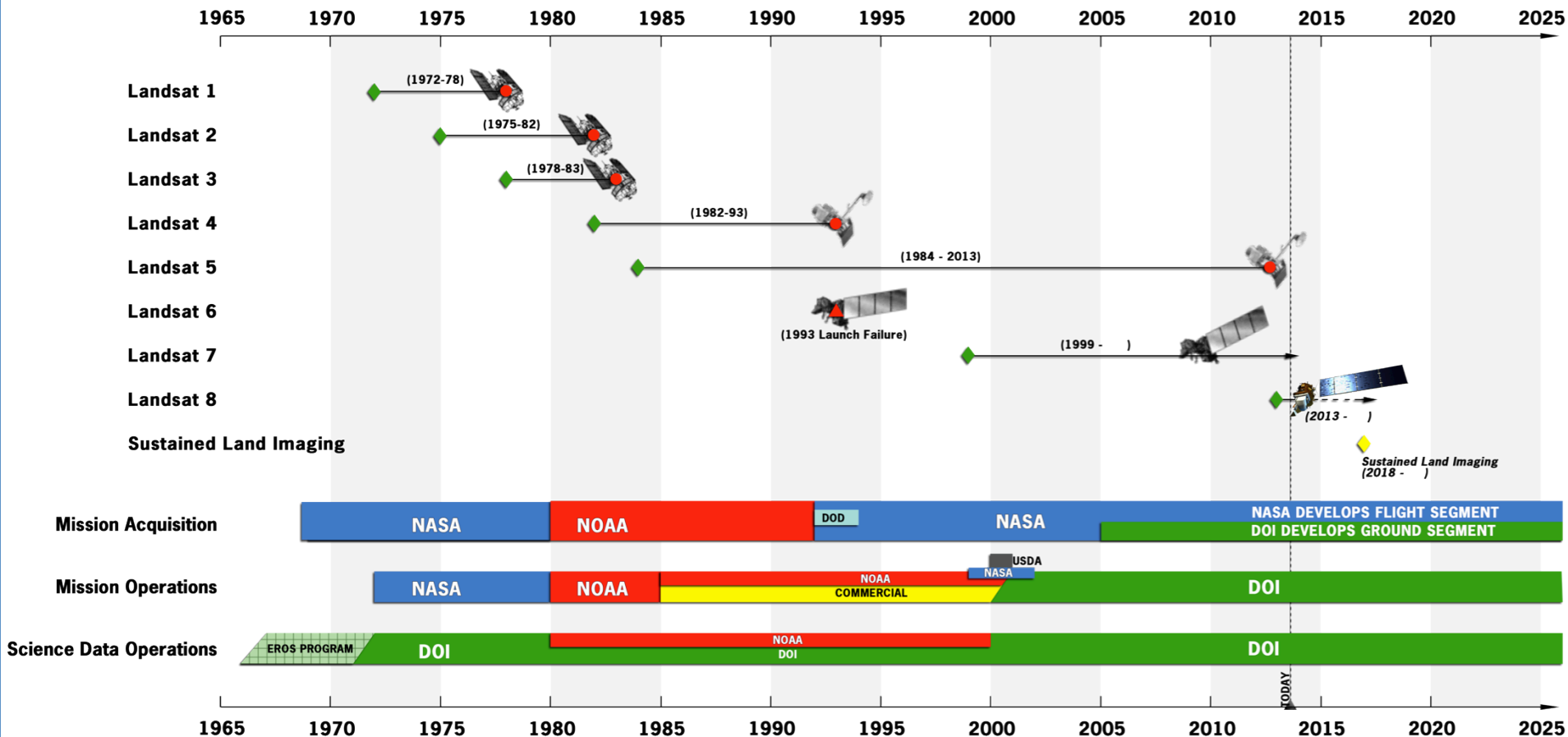
- Following four decades of successful imaging under changing program management structure and objectives, one-off satellite builds, and uncertainty about the future, we are now on a path toward sustained land imaging.

National Space Policy/USGS Responsibilities

The Secretary of the Interior, through the Director of the USGS, shall:

- Conduct research on natural and human-induced changes to Earth's land, land cover, and inland surface waters and **manage a global land surface data national archive and its distribution;**
- **Determine the operational requirements for** collection, processing, archiving, and distribution of land surface data to the U.S. Government and other users; and
- In support of these needs, **the Director of the USGS and NASA Administrator shall work together in maintaining a program for operational remote sensing observations.**

USGS/NASA Landsat Partnership Since 1966



NASA/USGS Landsat Roles

NASA:

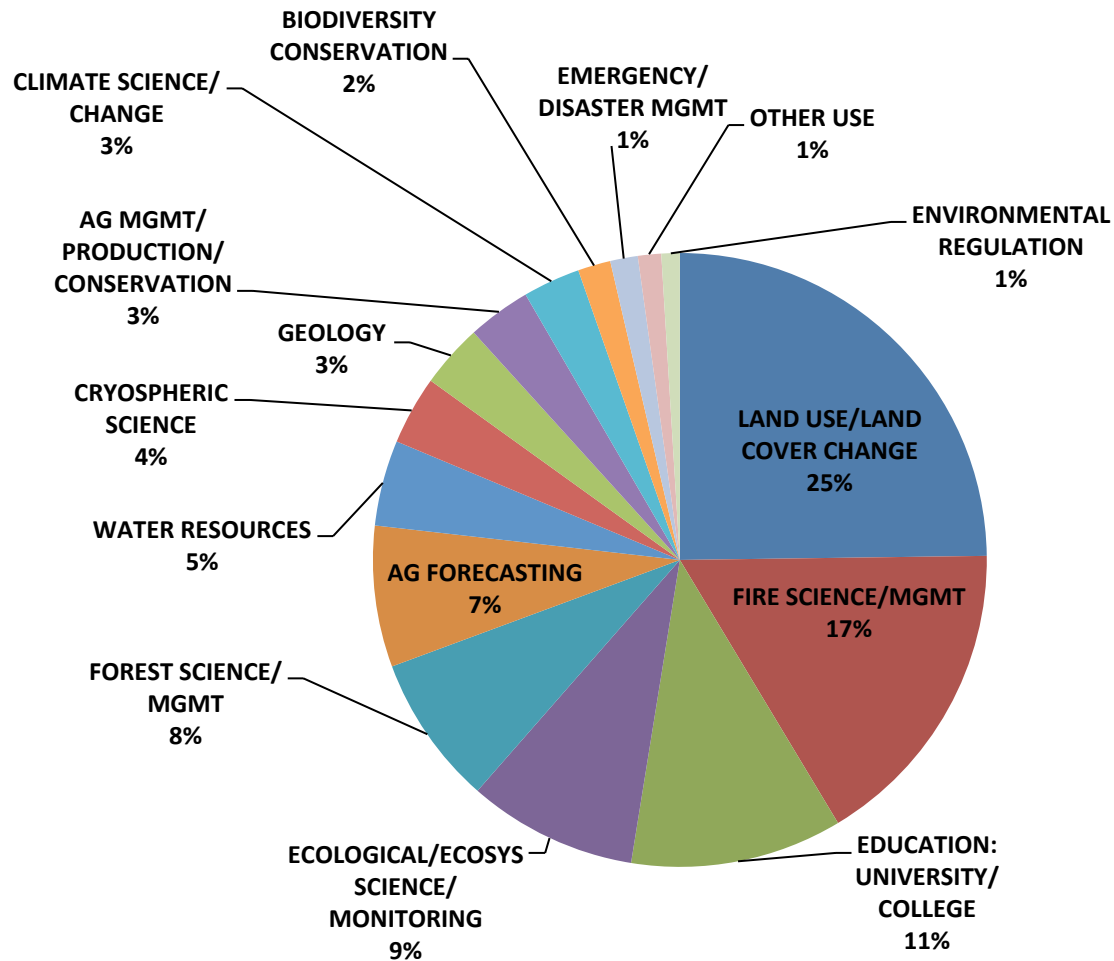
- Develops sensors, satellites, and launches land imaging space systems
- Co-chairs USGS-funded Landsat Science Team
- Performs Earth-system measurements and research using land-image data

USGS:

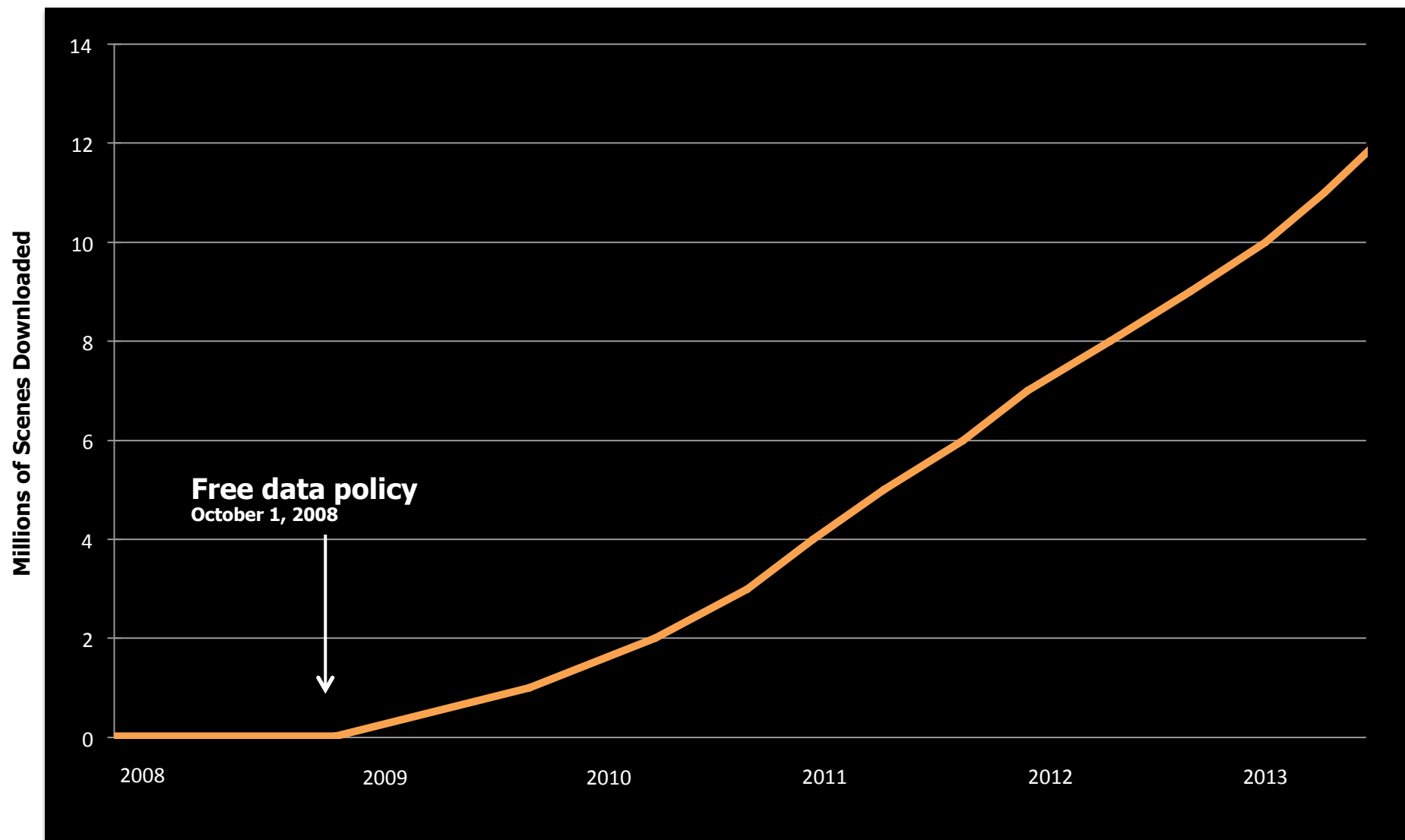
- Documents user land imaging requirements
- Develops ground systems for land imaging space systems
- Operates land imaging satellites
- Collects, processes, archives and disseminates land-image data
 - Establishes global land-coverage acquisition strategy
 - Coordinates International Partner ground receiving station network
 - Distributes data and information products at no charge
 - Develops new data products and applications

Landsat Data Users

Oct. 2012 – Apr. 2013



Increasing Demand for Free Landsat Data



What Users are Downloading

Landsat 8

- USGS assumed operational responsibility from NASA on May 30, 2013
- Collecting approximately 500 new scenes per day
- Restored 8 day revisit cycle lost when Landsat 5 was decommissioned
- Improvements: better signal-to-noise, new bands (coastal blue, cirrus, thermal)
 - Better resolution of snow and ice-covered regions
 - Detection of water column constituents
 - Better cloud screening
 - More precise temperature measurements

Landsat 7

- Collecting nearly 400 new scenes per day
- About 22% of pixels are missing per scene (faulty scan-line corrector)
- Sufficient fuel for a few more years of operation; limited subsystem redundancy

Landsat-based Information Products

- Standard orthorectified L1T calibrated radiance Landsat products
- LandsatLook (full-resolution JPEGs)
- New TM/ETM+ surface reflectance Climate Data Record (CDR) product
- New OLI surface temperature CDR in development
- Surface Water Extent, Burned Area Extent ECVs available soon for evaluation
- Snow-covered area Essential Climate Variable (ECV) late next year



2012 Landsat Application Survey

In 2012, USGS and NASA surveyed application requirements to:

- Document observation needs across a wide array of applications
- Determine impacts of particular mission designs

Gathered details on representative applications, not every use of Landsat

- Focused on a diverse set of established operational Landsat applications, primarily at the Federal or State levels
- In addition, a small number of "emerging" applications were selected

Designed to connect to other analyses:

- Interagency and international use of Societal Benefit Areas
- USGS National Land Imaging Requirements Project (2012-present)
 - Developing Earth Observation Requirements Evaluation System
 - Built on results of 2012 Survey, OSTP, NOAA activities
 - Collect and maintain requirements in a solution-agnostic approach

Landsat Applications Surveyed

		Green: Required for application				Blue: Helpful for application			
Application	Landsat Information Product	Spectral Requirements				Revisit			
		VIS	NIR	SWIR	TIR	4d	8d	16d	30d
National Land Cover Database (NLCD)	Cover type/change								
	% Tree cover								
	% Impervious								
USGS/USFS Landfire	Vegetation characteristics								
	Disturbance								
Burned Area Emergency Response (BAER)	Burn severity maps (dNDVI, dNBR)								
FAO FRA Forest Change	Forest change maps								
Foreign Agricultural Service (FAS)	Crop area								
	Crop production								
	Crop health								
National Agricultural Statistical Service (NASS)	National cropland data layer (crop type)								
USDA Crop Insurance	Verification of crop insurance/damage claims								
Western States Evapotranspiration	Land surface temperature								
	Surface reflectance								
	NDVI								
	Cloud/shadow mask								
USDA Tillage/Residue Monitoring	Crop residue								
Landsat Image Mosaic of Antarctica (LIMA)	Ice sheet features								
Minnesota Lake Clarity Monitoring	Water clarity								
USFS Forest Management	Terrestrial Ecological Unit Inventory								
	Mid-level Vegetation Classification								
	National insect disease risk map (NIDRM)								
	Post-storm damage assessments								
	Rapid Assessment of Vegetation (RAVG)								
MDA/NGA Land Change	Correlated land change (new construction)								
Ohio Agricultural Tax Verification	NDVI (to establish presence of crops)								
USGS Volcano monitoring	At-sensor radiance (plumes, minerals)								
	Surface temperature								
USGS Flood Monitoring	At-sensor radiance (flooded area)								
USGS Essential Climate Variables	Surface reflectance								
	Surface temperature								
	Land Cover / Surface Water								
	LAI/fPAR								

Results of 2012 Landsat Applications Survey

Spectral: Confirmed Shortwave Infrared (SWIR) and Thermal Infrared (TIR) are important components of a Landsat architecture

- Only 10% of applications can be satisfied with Visible-Near Infrared (VNIR) alone
- SWIR required in more than 75% of applications
- Only 30% of applications specified TIR, but TIR is also critical for accurate identification of clouds—fundamental to most VNIR-SWIR applications

Spatial: Reaffirmed 30m resolution as ideal for characterizing anthropogenic and natural changes on the landscape

Revisit: Verified 8-day revisit is an established, key user requirement

- About 30% of applications can be satisfied with 16-day revisit
- 8-day or better revisit required in about 70% of applications
- 10% of applications require even better than 8-day revisit

2012 survey confirmed operational uses of current Landsat capabilities

Future Directions

- **In a Landsat 9 timeframe (data acquisition beginning in 2018), there are a few options available that meet requirements, ranging from a clone of Landsat 8 to options requiring new technology development.**
 - These near-term solutions have varying levels of cost and risk
 - Several partial solutions may provide sufficient data to augment the Landsat data stream or partially mitigate a data gap
- **Technology development and demonstration now should significantly reduce costs, improve performance, and/or decrease risks in the timeframe of 2023 and beyond.**
 - A number of promising instrument and platform technologies (including hyperspectral imaging, smallsats, cheaper launch vehicles, hosted payload opportunities, etc.), but significant development required
 - Revolutionary developments underway in ground systems; processing and dissemination approaches will benefit from new concepts and technologies

Key Challenges for the 2013 RFI

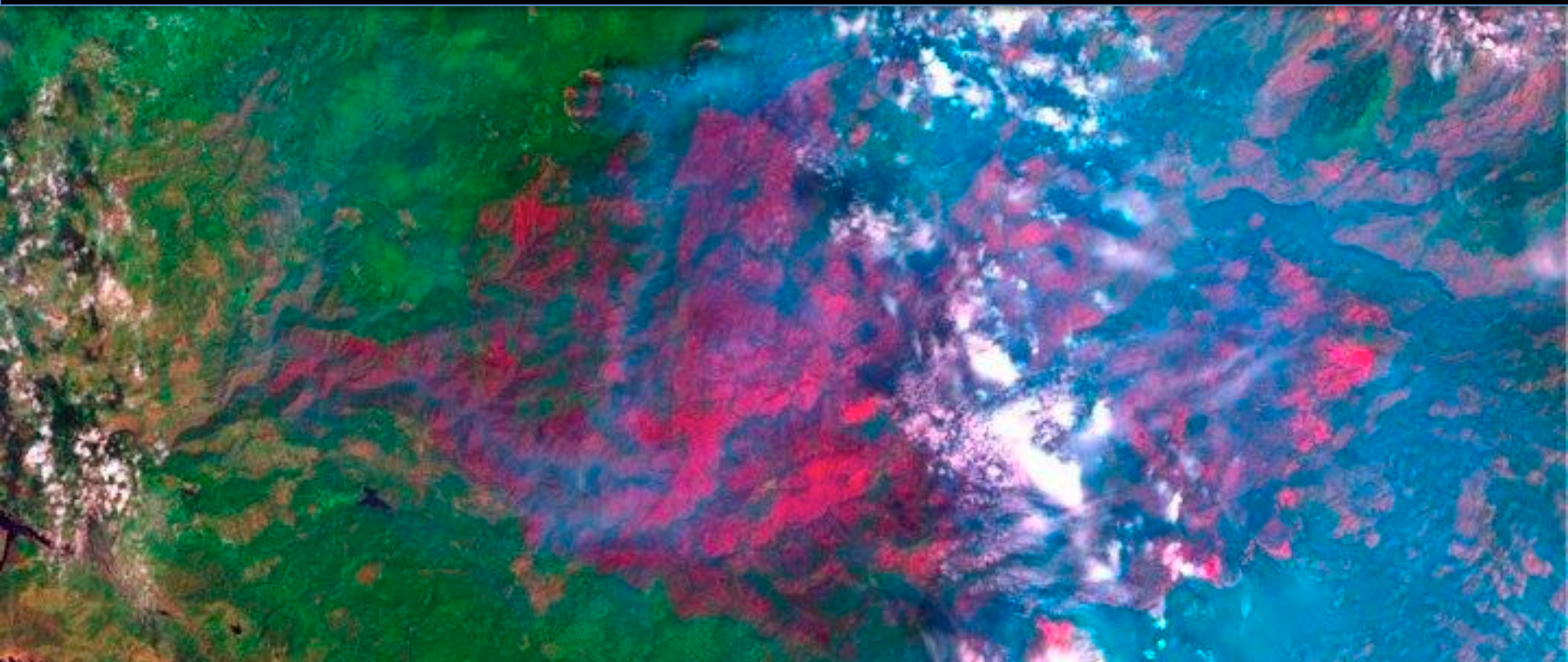
- **USGS sees two connected challenges:**
 - **Near-term need for observational continuity given:**
 - Landsat 7 reaching end of fuel in the next 3–4 years
 - Landsat 8 Thermal Infrared Sensor design life of 3 years (Class C instrument)
 - **Long-term need to ensure continuation and continual improvement of satellite-based land imaging**
- **Both challenges need to consider:**
 - **Observational requirements necessary to preserve continuity with the 41-year archive**
 - **Risk tolerances of this operational program**
 - **Goal of lowering the overall costs associated with:**
 - Building, launching and operating future space segments
 - Ground systems and data and information archival processing systems

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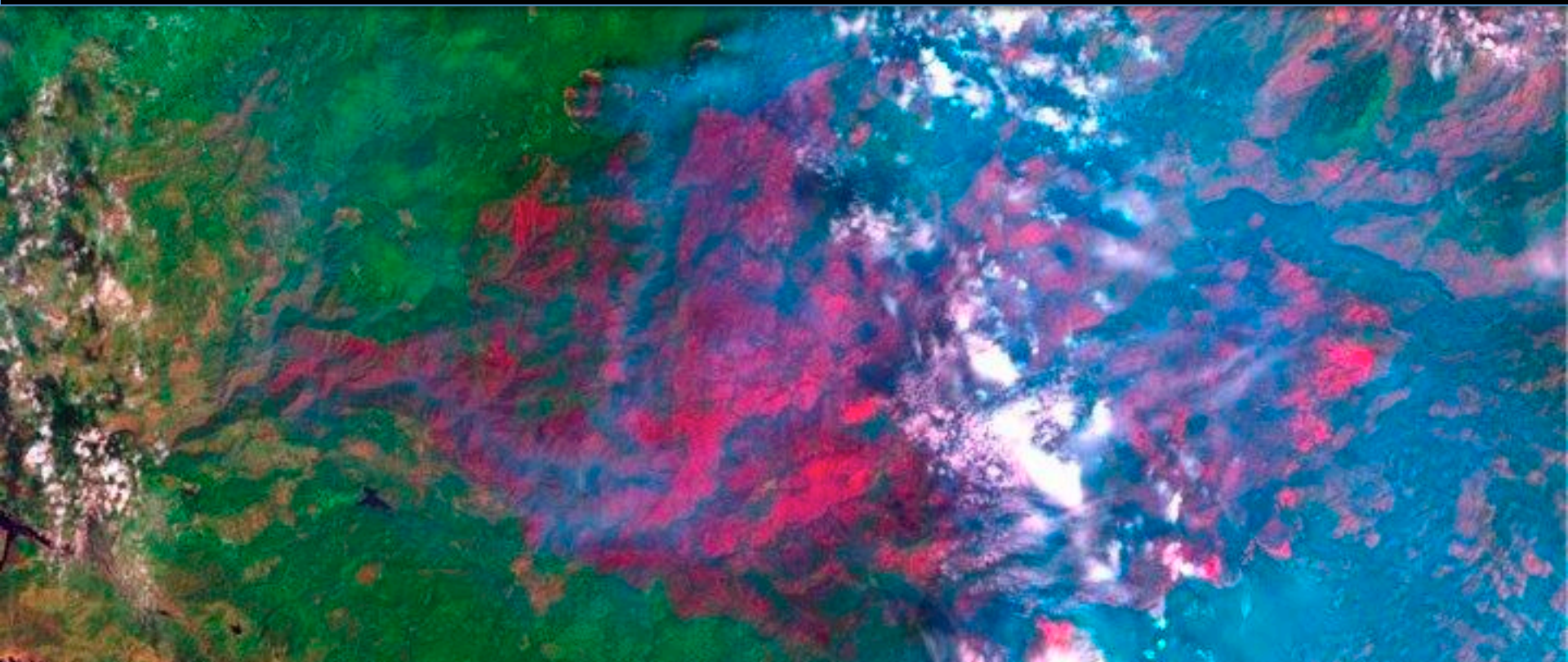


NASA Sustainable Land Imaging Program

Michael Freilich
Director
NASA Earth Science Division
September 18, 2013



SUSTAINABLE LAND IMAGING ARCHITECTURE STUDY INDUSTRY & PARTNER DAY



NASA Sustainable Land Imaging Program

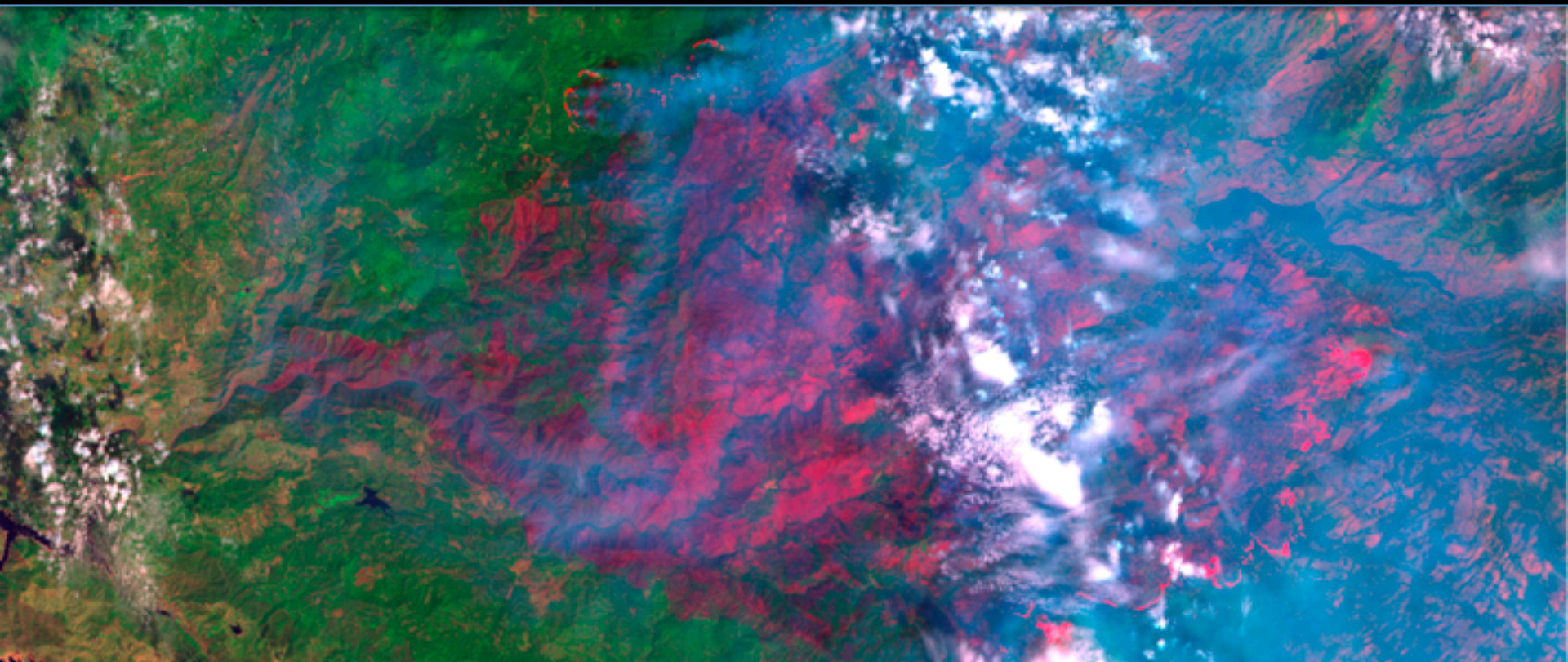
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Study Implementation Plan

David B. Jarrett
Program Executive
NASA Earth Science Division
September 18, 2013

Land Imaging in FY 2014 President's Budget for NASA

*In FY14 NASA will initiate the definition of a sustained, space-based, global land imaging capability for the nation, ensuring continuity following LDCM. Near-term activities led by NASA, in cooperation with USGS, will focus on **studies** to define the scope, measurement approaches, cost, and risk of a viable long-term land imaging system that will achieve national objectives. Evaluations and design activities will include consideration of stand-alone new instruments and satellites, as well as potential international partnerships. It is expected that NASA will support the overall system design, flight system implementation, and launch of future missions, while USGS will continue to fund ground system development, post-launch operations, and data processing, archiving, and distribution.*

- President's FY 2014 Budget release

NASA – USGS Collaboration

Study Phase

- NASA will lead the overall system architecture study, utilizing its space systems engineering expertise
- USGS will support all aspects of the study; USGS will represent the consolidated needs and desires of the Landsat user communities and provide expert analyses of the data processing and data dissemination aspects of the system

Implementation Phase

- NASA will be responsible for the overall system design, as well as the implementation, launch, and commissioning of the system's space-borne elements
- USGS will provide unique expertise and guidance in the design of the operations, ground network, data processing (including integration of measurements from multiple sources), and data dissemination components of the complete system
- USGS will be responsible for operating the space-borne assets after commissioning, as well as the downlink, ground processing, archiving, and distribution of the system's information and data products
- The USGS will maintain the national archive of Landsat data, distribute data to users, and administer, on behalf of the U.S. Government, data acquisition by non-USG ground stations.

Study Objectives

- Define a system for delivering sustained global land-imaging multispectral and thermal infrared information for an approximately 20-year period starting in 2018
- Provide options which consider various weightings of near-term capability, continuity/gap risk mitigation, technology infusion over the system's lifetime, and cost
- Consider refined capabilities requested by the user communities
- Include consideration of new measurement approaches, as well as potential international and private sector partnerships
- Provide complete system architecture recommendations to the Executive Office of the President by August 15, 2014

Cost Factors

- Programmatic stability recognizes that system cost is a critical parameter in the overall design
- The NASA budget includes development, launch, and commissioning of the space-borne assets
- The USGS budget includes mission operations, ground systems, and data archiving and distribution
- Trade-offs between the space and ground elements must factor in the budget constraints of each Agency

Architecture Study Approach

- NASA and USGS are establishing the Land Imaging Architecture Study Team (AST) within the NASA Earth Systematic Missions Program Office
 - Will include representatives from NASA Centers, USGS, JPL, Aerospace, others
 - Will be informed by the RFI responses
 - Will conduct independent analyses
 - Will conduct architecture feasibility studies
- NASA is releasing an RFI today (9/18/13) with inputs due in 30 days
 - Responses will be used as an input to the study
- The AST will present initial findings to NASA and USGS
- NASA and USGS will hold a Community Workshop to communicate architecture options and to elicit feedback
- The AST will refine architecture options and present them to NASA and USGS for final review and evaluation
- The study activity will result in recommendations and an implementation plan for a Sustainable Land Imaging System (combined space and ground system) to be provided to the Executive Office of the President by August 15, 2014

Community Engagement

NASA and USGS will communicate the progress of the study with the community at established, planned events:

October 2013	Landsat Science Team Meeting
December 2013	USGS/NASA User's Workshop (target)
February 2014	American Meteorological Society (AMS) Meeting
April 2014	American Society for Photogrammetry and Remote Sensing (ASPRS)/Joint Agency Commercial Imagery Evaluation (JACIE) Meeting
April 2014	NASA/USGS Community Workshop (target)

Request for Information

- On behalf of the joint agency Architecture Study Team, NASA is seeking information on system concepts and innovative approaches for the Sustainable Land Imaging Architecture study, including a range of solutions:
 - Large and small dedicated spacecraft
 - Formation flying
 - Hosted instruments
 - Integration of other land imaging data sets
 - International collaborations
 - Private sector partnerships
- We are also seeking information on, and will give careful consideration to, current and future planned ground system capabilities in light of those provided by the established USGS Earth Resources Observation and Science (EROS) Center.
- RFI responses should recognize that lowering the system's overall cost to the nation is an important goal, and that implementing an affordable system is an essential programmatic requirement for the U.S. Government.
- NASA is especially looking for complete system architecture solutions addressing all of the observational and data parameters, as specified in the provided Landsat 8 Reference Parameters. NASA also welcomes concepts that may address portions of those parameters and their performance capabilities.
- NASA is also interested in ideas for flexible system designs that efficiently enable technology infusion and evolution of measurement approaches over the lifetime of the system.

RFI Responses (1 of 2)

Organization information: Organization name and address, point-of-contact name, E-mail address, phone number.

Abstract: Provide a brief summary of the system concept or participatory engagement approach.

System concept: Describe the system concept and functions, how it addresses the objectives and requirements in this RFI, and its maturity (Technology Readiness Level) both at present and projected with a maturation plan at the time of implementation (if for a future capability).

Development approach: Outline the approach and timeline for developing and testing the system concept.

Performance Capability: An addendum to this RFI at <http://espd.gsfc.nasa.gov/landimagingstudy/> provides a synopsis of LDCM science mission level specifications as potential reference parameters for RFI responses. In this regard, RFI responses should compare the capabilities and characteristics of future land imaging system concepts to those reference parameters.

Calibration: Describe the methods used or planned for providing calibrated data (i.e., how is data quality maintained), and validating that the data meet specifications.

Technology Evolution or Infusion: Describe the aspects of the system concept that will evolve over the lifetime of the program and how that technology will be infused in the described mission architecture.

System Cost Estimate: Provide an estimate of the cost to build, implement, and operate the system concept with accompanying assumptions and rationale (for reference purposes only).

RFI Responses (2 of 2)

- The RFI will be released today at 4:30 p.m. (EDT)
<http://espd.gsfc.nasa.gov/landimagingstudy/>
- Responses are due by 5 p.m. (EDT) on October 18, 2013
Responses should be addressed to
David B. Jarrett
HQ-LandImaging-RFI@mail.nasa.gov
Subject Line: RFI for Land Imaging Study
- Responses should be in PDF format with a 20-page limit and not greater than 8 MB in size.
- Only material suitable for full and open distribution shall be submitted. No proprietary, export controlled, classified, or sensitive material should be provided.
- The RFI is for planning and information purposes only and is not to be construed as a commitment by the Government to enter into a contractual agreement, nor will the Government pay for information solicited.

FY 14 Schedule

1st Quarter FY 14

- Receive RFI Inputs
- Perform initial system and specialty trade studies
- Conduct User's Workshop

2nd Quarter FY 14

- Triage multiple system architecture approaches
- Conduct Community Workshop to solicit community feedback

3rd Quarter FY 14

- Refine final system architectures
- Produce final report and implementation plan

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Questions

- Please wait for the microphone
- Please state your name and affiliation, then your question
- For questions submitted via e-mail, please include your name and affiliation
- We will intersperse questions from the audience with those received via e-mail

Questions

HQ-LandImaging-RFI@mail.nasa.gov